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NEW RECORDS AND NEW SPECIES OF BITING MIDGES FROM SALT MARSHES IN CALIFORNIA AND MEXICO (DIPTERA: CERATOPOGONIDAE)

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The description of a new species of *Culicoides* Latreille is presented here to make the name available for use by the junior author in reporting his studies on the ecology of the Anaheim Bay, Salt Marsh in California. At the same time a redescription and new distribution records are given for its nearest relative, *C. mohave* Wirth, and a third species of this group from coastal Mexico is described. Two species of *Dasyhelea* Kieffer recently described by Wirth (1978) from Baja California and Sonora, Mexico, are also reported from Anaheim Bay, and taxonomic and distributional notes are provided for these species. Terminology used in the descriptions follows that of Wirth (1952) and Wirth and Blanton (1959). Holotypes are deposited in the United States National Museum of Natural History in Washington, D.C.; paraptypes will be deposited in the California Academy of Sciences in San Francisco and the Los Angeles County Museum in Los Angeles.

Along the Pacific Coast of the United States there are only a few salt marshes which have not been greatly modified by land fills, dredging, marinas, or other enterprises. The Anaheim Bay Salt Marsh (see map, Fig. 1), Orange County, California, is one of these, and it may represent the typical flora and fauna of California marshes. Much of this salt marsh is within the boundaries of the Seal Beach Naval Weapons Station, and the marsh area has been set aside as a National Wildlife Refuge. The Anaheim Bay Salt Marsh has the typical floral zonations with *Salicornia* (pickleweed) in the lower zone, *Spartina* sp. (cordgrass) in the middle, and *Distichlis* (salt grass) in the upper zone.

The *Dasyhelea* and *Culicoides* from Anaheim Bay were collected with fluorescent black-light traps suspended one meter above the soil surface in areas where pickleweed and cordgrass were the dominant vegetation and submerged by high tides. The ceratopogonids were abundant and as many as 4000 specimens of *Culicoides* and 37,000 specimens of *Dasyhelea* were

Fig. 1. The Anaheim Bay Salt Marsh, 1970. Darkened areas represent mud flats exposed between low and mean high tides. All areas are flooded at extreme high tides, except for islands and roads.

collected during the 12 month sampling program. The *Dasyhelea* are non-bloodsuckers and the larvae are found on the surface of the intertidal mud or rocks where they feed on various algae.

Culicoides mohave Wirth
(Figs. 2, 5)

Culicoides mohave Wirth, 1952:187 (male, female; Calif., Ariz., fig. wing, palpus, male genitalia).

Female (paratype, Vidal, Calif.).—Wing length 1.09 mm; breadth 0.55 mm.

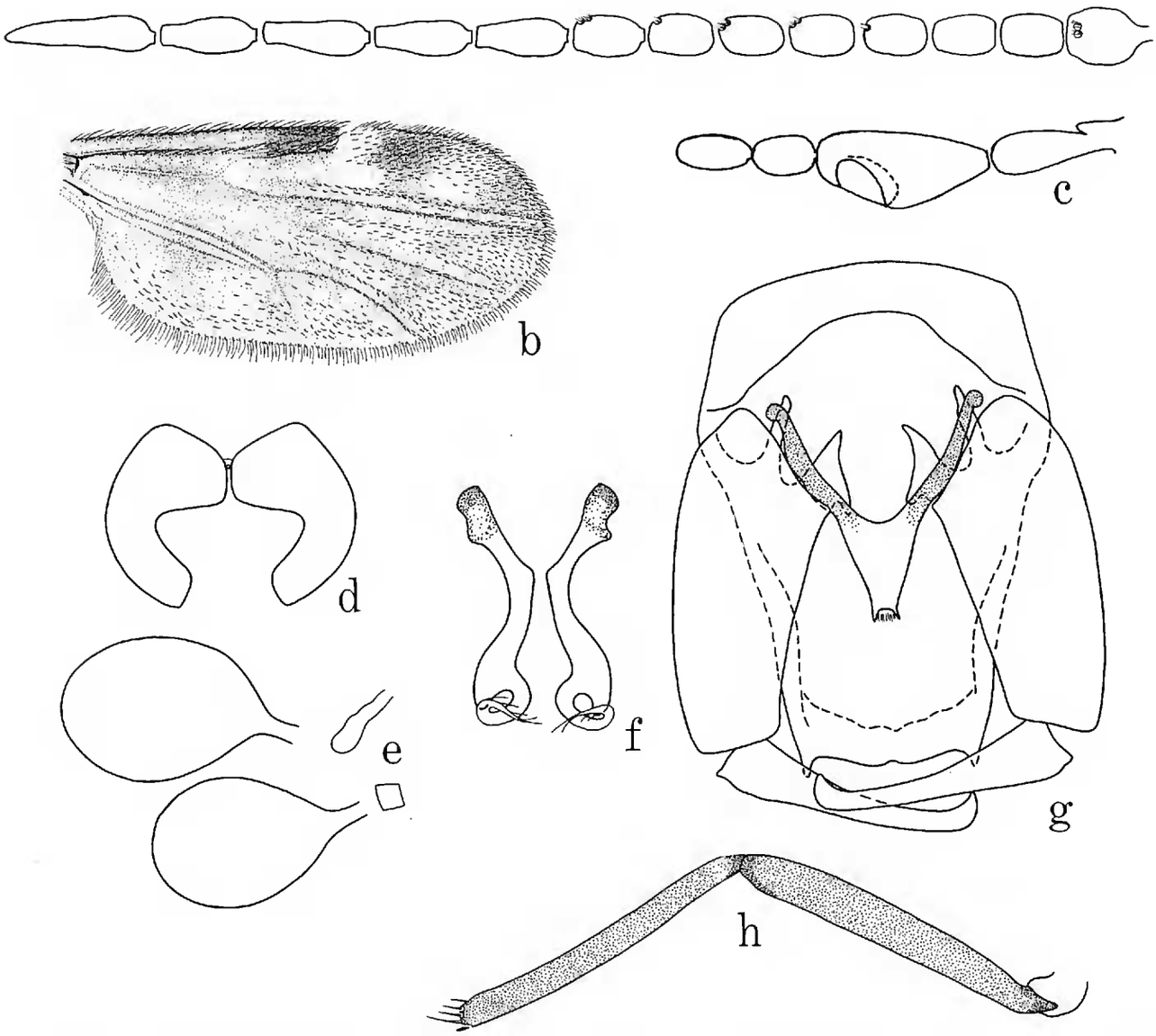


Fig. 2. *Culicoides mohave* Wirth: a–e, h, female; f–g, male; a, antenna; b, wing; c, palpus; d, eye separation; e, spermathecae; f, parameres; g, genitalia, parameres removed; h, hind femur and tibia.

Head.—Eyes (Fig. 2d) narrowly separated, bare. Antenna (Fig. 2a) with lengths of flagellar segments in proportion of 28-20-20-20-20-21-21-21-30-33-33-35-58; antennal ratio 1.11; last segment rather slender toward tip; sensilla coeloconica (distal sensory pits) present on segments 3, 6–10 or 3, 7–10. Palpus (Fig. 2c) with lengths of segments in proportion of 15-35-52-16-20; palpal ratio 2.1; third segment distinctly swollen, with a broad, shallow, sensory pit. Proboscis short, P/H ratio 0.67; mandible with 14 teeth.

Thorax.—Brown with pale grayish pollinosity, mesonotum without distinct pattern. Legs stramineous, knee spots dark brown, faint narrow pale rings present at bases of tibiae (Fig. 2h); hind tibial comb with four spines, the one nearest the spur longest. Wing (Fig. 2b) with pattern as figured; very dark costal spot extending to tip of second radial cell; pale spot over r-m crossvein not very distinct, extending caudad past medial stem; cell R5 with a distinct poststigmatic pale spot extending proximad behind second

radial cell, a more or less rounded pale spot toward apex of cell R5, its size variable but usually meeting anterior wing margin; cell M1 with two elongate pale spots, the distal one not meeting wing margin; cell M2 with an indistinct pale spot lying behind medial fork, a pale spot at level of pale spot in cell M4, and a pale spot at wing margin; cell M4 with a large round pale spot in distal portion; anal cell more or less pale at base and a single pale spot in distal portion; costal ratio 0.54; radial cells distinct, the second with broad lumen; macrotrichia long and moderately numerous, extending proximad nearly to base of anal cell. Halter pale.

Abdomen.—Pale yellowish brown, ninth segment brownish. Spermathecae (Fig. 2e) two plus rudimentary third and sclerotized ring; oval with long slender necks; slightly unequal, measuring 0.067 to 0.039 mm and 0.055 by 0.038 mm including the necks.

Male (Resting Springs, Calif.).—Wing length 1.00 mm, breadth 0.36 mm. Similar to the female with the usual sexual differences; costal ratio 0.46, costa unusually short in male of this species; antenna with lengths of last three segments in proportion of 60-47-60, sensilla coeloconica present on segments 3, 8–10. Genitalia (Fig. 2g): Ninth sternum with broad shallow caudomedian excavation, the ventral membrane bare; ninth tergum tapering distally, caudal margin slightly lobate, apicolateral processes small and pointed. Basistyle with ventral root foot shaped, the posterior heel well developed, toe rather stout, dorsal root moderately long and slender; dististyle long and slender, with bent pointed tip. Aedeagus with basal arch rounded, extending to 0.6 of total length, basal arms slender and curved; distomedian process tapering to rather slender, truncate tip bearing minute spinules. Parameres (Fig. 2f) each with distinct basal knob, rather straight and obliquely directed on basal portion, with a distinct median elbow at about a third of total length, this elbowed portion slender; midportion slightly expanded distally to well-developed ventral lobe; distal portion abruptly narrowed, slender, curving ventrad and tapering to distal point and bearing a lateral fringe of fine spines.

Distribution (Fig. 5).—Restricted to the desert areas of southern California and Arizona, and the northern portion of Baja California.

Types.—Holotype male (pinned with genitalia in microvial), allotype female, 2 males, 27 females (paratypes), Vidal, San Bernardino Co., California, IV-1948, R. Coleman, light trap (Type no. 59938, USNM).

Specimens examined.—

ARIZONA: *Cochise Co.*: Ramsey Canyon, Huachuca Mts., VII-1967, W. Brown, light, 5 females. *Pima Co.*: Quitobaquito, IV-26-1959, M. S. Adachi, 5 females.

CALIFORNIA: *Imperial Co.*: Imperial Dam, VI-28-1954, W. A. McDonald, at lights, 3 females. *Inyo Co.*: Resting Springs, V-29–30-1955, Belkin and McDonald, 3 males, 11 females; Saratoga Springs, Death Valley,

V-30-1953, J. N. Belkin, 1 male, 5 females; same, VI–VII-1954, Belkin and McDonald, 12 males, 18 females. *Riverside Co.*: Blythe, VII-20-1947, J. W. MacSwain, light trap, 1 male, 1 female; Mecca, V-1962, M. S. Mulla, 5 males, 5 females; 12 mi SE Mecca, IX-21-1965; J. D. Foulk, reared from damp sand, 1 male; Rancho Dos Palmas, VIII-7-1964, J. D. Foulk, light trap, 1 male; Salton Sea State Park, VIII-13-1964, J. D. Foulk, light trap, 1 male. *San Bernardino Co.*: Vidal, IV-1947, R. Coleman, light trap, 3 female paratypes.

MEXICO: *Baja California*: Arroyo de Calmajue, V-30-1962, Ryckman, Ryckman, and Christianson, at car lights, 1 male, 33 females; Mulege, VIII-27-1959, Radford and Werner, light trap, 33 females.

Discussion.—*Culicoides mohave* is the inland, desert inhabiting counterpart of the two new coastal species described below. It is most closely related to *C. bajensis,* which also has narrowly separated eyes and a broad third palpal segment, but differs most notably in its paler color with dull pruinose gray mesonotum, longer and finer wing macrotrichia, shallower palpal pit, and much shorter apicolateral processes on the male ninth tergum.

Culicoides bajensis, new species
(Figs. 3, 5)

Culicoides alahialinus Barbosa (misident.); Cheng and Hogue, 1974:215 (Baja Calif., reared crab holes, notes on habitat).

Female holotype.—Wing length 1.09 mm; breadth 0.50 mm.

Head.—Eyes (Fig. 3c) narrowly separated, bare. Antenna (Fig. 3a) with lengths of flagellar segments in proportion of 32-22-22-22-22-22-22-22-30-32-32-32-50; antennal ratio 0.95; sensilla coeloconica present on segments 3, 7–10 or 3, 8–10. Palpus (Fig. 3b) with lengths of segments in proportion of 15-40-60-16-23; third segment distinctly swollen, with a broad, rather deep sensory pit; palpal ratio 2.0. Proboscis moderately long, P/H ratio 0.81; mandible with 16 teeth.

Thorax.—Dark brown, subshining; mesonotum without prominent pattern. Legs brown, knee spots darker, tibiae with faint basal pale bands (Fig. 3g); hind tibial comb with four spines, the one nearest the spur longest. Wing pattern as in *C. mohave* but the pale spots usually slightly more extensive, the distal pale spot in cell R5 broadly meeting anterior wing margin; poststigmatic pale spot in cell R5 only slightly produced proximad behind second radial cell. Both radial cells well developed, costal ratio 0.57; macrotrichia sparser than in *C. mohave,* shorter and more spinelike. Halter pale.

Abdomen.—Brown, paler at base. Spermathecae (Fig. 3d) two plus ru-

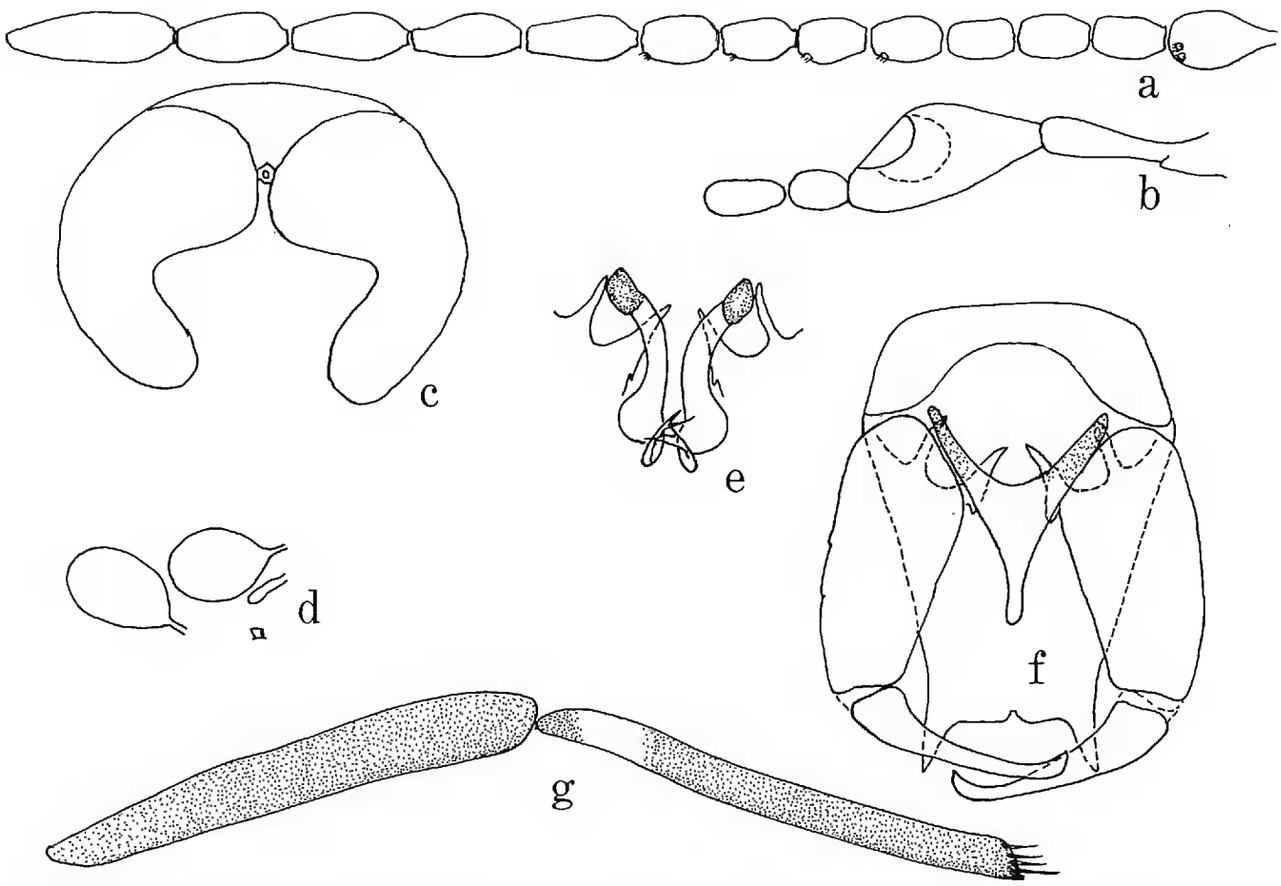


Fig. 3. *Culicoides bajensis* n. sp.: a–d, g, female; e–f, male; a, antenna; b, palpus; c, eye separation; d, spermathecae; e, parameres; f, genitalia, parameres removed; h, hind femur and tibia.

dimentary third and sclerotized ring; oval with long slender necks; subequal, each measuring 0.053 by 0.032 mm including the necks.

Male allotype.—Wing length 0.96 mm; breadth 0.36 mm. Similar to female with usual sexual differences. Palpal pit characteristically small and deep. Costal ratio 0.49. Antenna with lengths of last three segments in proportion of 73-46-55; sensilla coeloconica on segments 3, 8–12. Genitalia (Fig. 3f) with ninth sternum longer than in *C. mohave,* with a broad, moderately deep caudomedian excavation, ventral membrane bare; ninth tergum tapering distally with moderately long, slightly divergent apicolateral processes (shorter and stouter than in *C. hoguei,* but much longer than in *C. mohave*). Aedeagus with basal arch rounded, extending to 0.43 of total length, basal arms comparatively stout; distomedian process tapering to rather slender, bluntly rounded tip. Parameres (Fig. 3e) each with distinct basal knob, proximal portion slender and gradually curved, greatly expanded past midlength to a well-developed ventral lobe; distal portion abruptly narrowed, bent ventrad and tapering to slender distal point with lateral fringing spines.

Distribution (Fig. 5).—Coastal northwest Mexico (Baja California and northwest Sonora).

Types.—Holotype, female, allotype, male, 25 mi N Penjamo, Baja Cali-

fornia Sur, Mexico, VIII-29-1959, Radford and Werner, light trap (Type no. 62715, USNM). Paratypes, 8 males, 20 females, as follows:

MEXICO: *Baja California*: Bahia Balandra, VI-11-1968, C. L. Hogue and D. B. Bright, reared from burrow of crab, *Sesarma sulcatum,* 1 male; Isla San Jose, IV-21-1972, L. Cheng, at light on ship, 2 males, 6 females; Isla San Jose, 1 mi S Punta Colorado, IV-8–9-1974, J. T. Doyen, malaise trap, 2 males, 1 female (Calif. Acad. Sci.); Penjamo, 25 mi N, same data as types, 2 males, 7 females; Santa Rita, 9 km SE, VIII-25-1977, E. Fisher and R. Westcott, 1 male, 1 female (Calif. Acad. Sci.). *Sonora*: Cholla Bay near Puerto Penasco, IV-25-1959, M. S. Adachi, 2 males, 6 females.

Discussion.—Culicoides bajensis is a much darker species than *C. mohave,* slightly larger, and readily separated by the much deeper palpal pit (especially in the male) and by the longer apicolateral processes on the male ninth tergum.

Of the three species of the *mohave* group treated in this paper, *C. bajensis* is most similar to *C. alahialinus* Barboas, and its close similarity to *alahialinus* leads us to believe that the *mohave* group has evolved from a common ancestor with the *furens* group (see Wirth and Blanton, 1959) that was somewhat intermediate between *alahialinus* and *C. cancer* Hogue and Wirth (1968). The known members of the *furens* group resemble those of the *mohave* group in general features of the wing pattern, antennal and palpal proportions, antennal sensory pattern, spermathecae, and male genitalia, but all known species of the *furens* group possess a mesonotal pattern of small punctiform brown dots. In *C. alahialinus* the mesonotal pattern is rather faint, but in this species the wing is rather uniform grayish brown with an almost imperceptible pattern of a few pale areas, over the r-m crossvein, past the tip of the costa, at the tip of the anal cell, etc. *Culicoices cancer,* which also breeds in crab holes but is known only from Costa Rica, has a well-developed mesonotal pattern and a more prominent wing pattern than in *C. bajensis,* including the division of the poststigmatic pale spot in cell R5 into two separate pale spots, and the presence of two pale spots distally in the anal cell.

Hogue reared *C. bajensis* from a burrow of the crab *Sesarma sulcatum* at Bahia Balandra, west of La Paz, Baja California. The species was confused with *C. alahialinus* by Wirth, who furnished Hogue the misdetermination (Cheng and Hogue, 1974).

Culicoides hoguei, new species
(Fig. 4)

Culicoides mohave Wirth (misident.); Ryckman and Ryckman, 1963:65 (Baja California; biting man).

Female holotype.—Wing length 1.22 mm; breadth 0.56 mm.

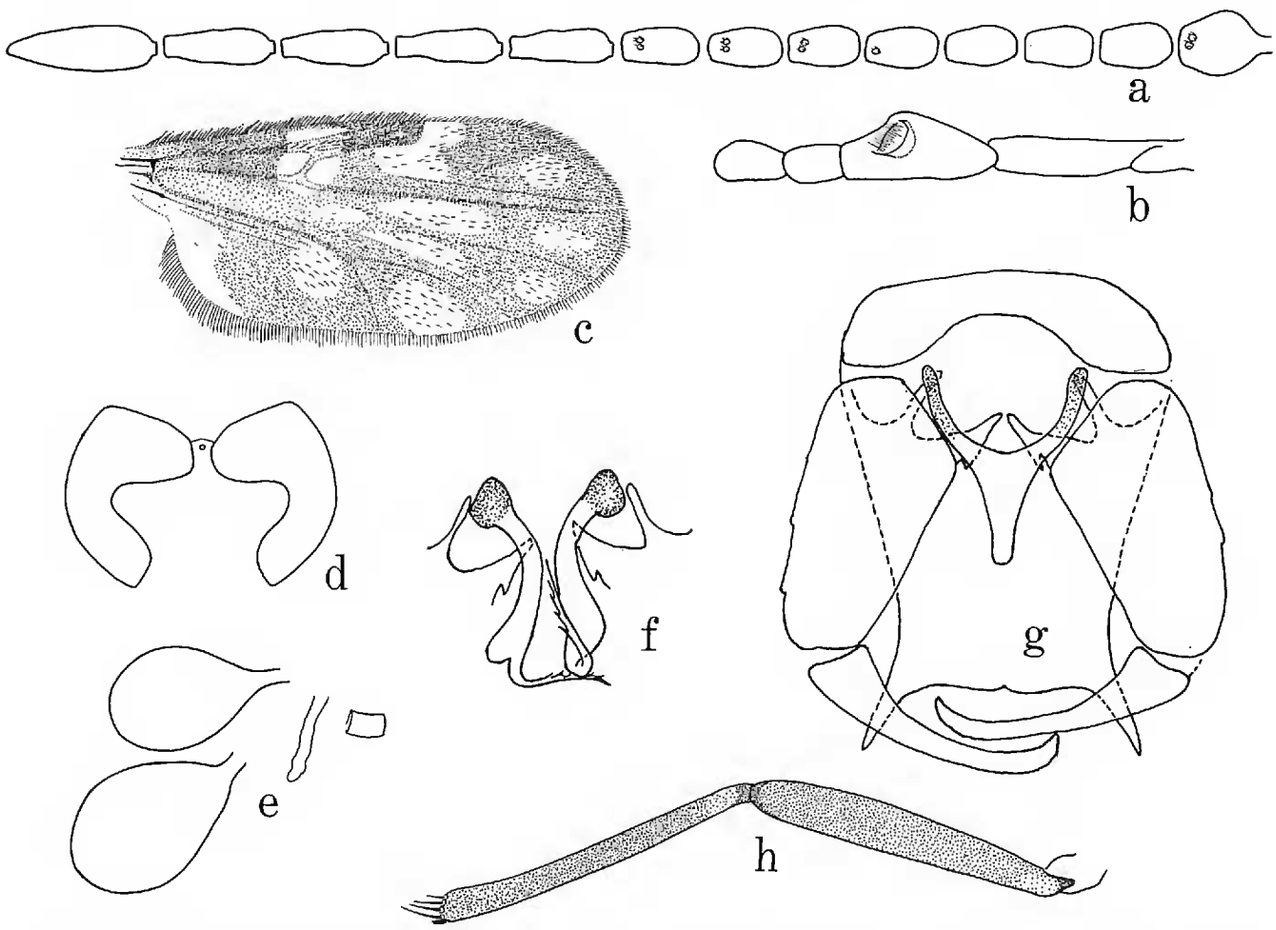


Fig. 4. *Culicoides hoguei* n. sp.: a–e, h, female; f–g, male; a, antenna; b, palpus; c, wing; d, eye separation; e, spermathecae; f, parameres; g, genitalia, parameres removed; h, hind femur and tibia.

Head.—Brown, antenna and palpus stramineous. Eyes (Fig. 4d) broadly separated, bare. Antenna (Fig. 4a) with lengths of flagellar segments in proportion of 30-25-25-25-25-26-26-26-30-33-35-36-50; antennal ratio 0.89; sensilla coeloconica present on 3,(7),8–10. Palpus (Fig. 4b) with lengths of segments in proportion of 15-40-50-21-30; third segment slightly swollen distally with a moderately large, moderately deep, round sensory pit; palpal ratio 2.5. Proboscis long, P/H ratio 0.94; mandible with 13 teeth.

Thorax.—Brown, without prominent pattern. Legs stramineous, knee spots brownish, tibiae (Fig. 4h) with faint basal pale rings; hind tibial comb with four spines, the one nearest the spur longest. Wing (Fig. 4c) brownish with rather indistinct pattern of pale spots as figured; similar to that of *C. mohave*; costal ratio 0.57; radial cells distinct, second with broad lumen; macrotrichia moderately long and numerous, extending proximad nearly to base of anal cell. Halter pale.

Abdomen.—Pale brown, distal segments darker. Spermathecae (Fig. 4e) two plus rudimentary third and sclerotized ring; oval with long slender necks; equal, each measuring 0.051 by 0.029 mm including the neck.

Male allotype.—Wing length 1.22 mm; breadth 0.45; coastal ratio 0.53. Similar to the female with the usual sexual differences. Antenna with lengths of last three segments in proportion of 70-58-58; sensilla coeloconica on segments 3, 8–12. Genitalia (Fig. 4g): Ninth sternum with broad, shallow caudomedian excavation, ventral membrane bare; ninth tergum slightly tapering distally, caudal margin transverse, apicolateral processes long and slender, slightly divergent. Basistyle with ventral root foot shaped, posterior heel well developed, toe long and slender, dorsal root long and slender; dististyle long and unusually slender, with bent pointed tip. Aedeagus with basal arch rounded, 0.45 of total length, basal arms slender; distomedian process tapering to slender rounded tip. Parameres (Fig. 4f) each with distinct basal knob, slender and curved basally, then somewhat swollen with a low ventral lobe, distad of which it is greatly narrowed and curved ventrally, tapering to slender point and bearing a lateral fringe of fine spines.

Distribution.—Coast of southern California and Gulf Coast of northern Baja California.

Types.—Holotype, female, allotype, male, 40 male, 55 female paratypes: Anaheim Bay Salt Marsh, Seal Beach Weapons Station, Orange Co., California, V-6-1974, P. Moraes, light trap (Type no. 61315, USNM).

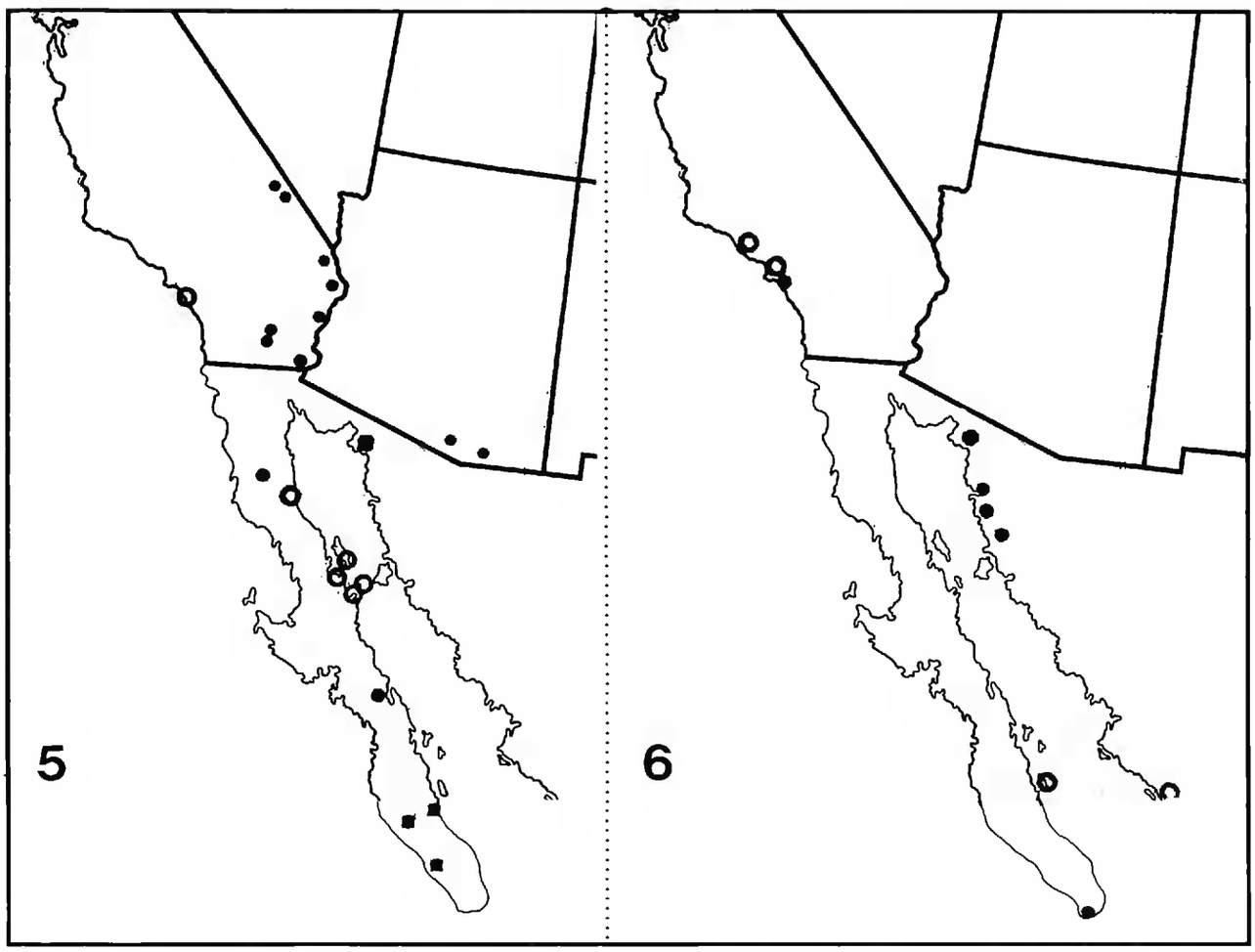
Other specimens examined.—MEXICO: *Golfo de California*: Isla Miramar, VIII-17-1977, J. Nyhan, 1 female (Calif. Acad. Sci); Isla Pond near Isla Angel de la Guardia, V-25-1962, Ryckman, Ryckman and Christianson, biting man, 3 females; Isla San Esteban, V-24-1962, Ryckman, Ryckman, and Christianson, biting just after dark, 1 female; Isla Salsipuedes, V-22-1962, Ryckman, Ryckman, and Christianson, biting man, 4 females; Isla San Lorenzo, V-22-1962, Ryckman, Ryckman, and Christianson, biting after dark, 4 females.

Variation.—Some minor variation exists in the extent of the pale wing markings, in size, and in structural characters. For example on the female figured (from Isla Salsipuedes) the wing length was 1.33 mm, the costal ratio 0.56, the antennal ratio 0.93 proboscis/head ratio 0.74, and number of mandibular teeth 18. For this reason the Baja California specimens are not designated as paratypes.

Discussion.—This species is named for Dr. Charles L. Hogue of the Los Angeles County Museum in recognition of his extensive contributions to our knowledge of the biology of the intertidal zone of the Pacific Coast.

Culicoides hoguei is closely related to *C. mohave* Wirth and *C. bajensis* n. sp., from which it is readily separated in the female by the broad interocular space and the slender third palpal segment, and in the male by the less tapering distal process on the aedeagus and the long, slender, diverging apicolateral processes on the ninth tergum.

Ryckman and Ryckman (1963) reported this species (as *C. mohave,* based



Figs. 5, 6. Fig. 5. Distribution of *Culicoides* spp.: closed circles, *C. mohave*; open circles, *C. hoguei*; closed squares, *C. bajensis*. Fig. 6. Distribution of *Dasyhelea* spp.: closed circles, *D. sonorensis*; open circles, *D. bajensis*.

on misdeterminations by Wirth) biting man at several localities in Baja California. These records are listed above in the list of paratypes. The Ryckmans (1963) reported on their encounter with this species on the islands of the Gulf of California as follows: "Because these islands were extremely dry and barren with very little rotting vegetation (other than cacti), we believe that *Culicoides mohave* was probably breeding in organic material on the beaches surrounding the islands. After a few days on the islands, our faces and arms bore small, raised, light welts where we had been bitten by the jejen. One's length of time on the islands could to some degree be predicted by the presence and number of such welts."

"*Culicoides mohave* was collected while feeding on man on the following islands under the conditions indicated: Salsipuedes Island, May 22, 1962; South San Lorenzo Island, May 22, 1962, biting in the shade at 2:10 p.m., also biting just after dark; San Esteban Island, May 23, 1962, biting at daybreak; Pond Island, May 26, 1962."

We are unable to explain the lack of records of this species feeding on

man at Anaheim Bay, while it caused the Ryckmans so much trouble on the Baja California islands. We suspected at first that two different but closely related species were involved, but an especially detailed search for morphological differences yielded only the minor features listed above, which in our opinion are not distinct enough to warrant description of another species. Perhaps the study of male specimens from Baja California will reveal greater differences, or the collection and study of the immature stages will help us resolve this problem.

Dasyhelea bajensis Wirth
(Fig. 6)

Dasyhelea sp.; Cheng and Hogue, 1974:214 (habitat notes; Baja California).
Dasyhelea bajensis Wirth, 1972:192 (male, female; Mexico, California; figs.).

Diagnostic characters.—A small species, wing length 0.90 mm. Pale brown, mesonotum with sides and humeri yellowish forming two pairs of broad longitudinal vittae on midportion; scutellum and legs yellowish; antenna and abdomen brownish. Wing milky white to pale grayish; halter pale. Female subgenital plate as in *mutabilis* group, with a distinctive anterior sclerotized ring; spermatheca single, subspherical, with a long, slender, curved, petiolelike neck about as long as diameter of spermatheca. Male genitalia with ninth tergum rounded caudad, with minute apicolateral processes; basistyle stout with distinct mesal hump at midlength, dististyle slender, curving to pointed tip; aedeagus forming a more or less equilateral triangle, basal arch low, distomedian process in form of a spatulate blade with truncate tip, a pair of slender basal processes arising laterally on basal arch and nearly meeting mesad at half the length of distomedian process; parameres asymmetrical, basal apodemes forming a slender transverse ribbon, posterior median process short and broad, divided near base and forming a pair of curved, pointed, laterally directed plates.

Distribution (Fig. 6).—*Dasyhelea bajensis* was described from a series taken in an emergence trap under mangroves near the edge of a wet swamp on Isla San Jose, Baja California, Mexico, by Lanna Cheng (Cheng and Hogue, 1974). The species was also reported from Mazatlan, Sinaloa, Mexico. Five specimens were also recorded from Point Mugu, Ventura Co., California. Taken VIII-17-1947 by J. N. Belkin.

New records.—CALIFORNIA: *Orange Co.*: Seal Beach Weapons Station, Anaheim Bay Salt Marsh, V-6-1974, P. Moraes, light trap, 2 males, 4 females.

Cheng and Hogue (1974) recorded this species (as *Dasyhelea* sp.) from Isla San Jose, where it was taken in emergence traps placed on the mud

amongst aerial roots of *Avicennia* mangroves at the lower tide levels where the mud surface remained submerged except during low spring tides.

Dasyhelea sonorensis Wirth
(Fig. 6)

Dasyhelea sonorensis Wirth, 1978: 197 (male, female; Mexico; figs.).

Diagnostic characters.—A medium-sized species, wing length 1.34 mm. Brownish, mesonotum dull yellowish on sides and humeri with narrow lines on the disc forming two pairs of darker longitudinal vittae; scutellum and legs yellowish. Wing whitish, slightly milky, macrotrichia long and moderately numerous; halter pale, base of knob dark. Female subgenital plate as in *mutabilis* group, the anterior sclerotized ring rather quadrate; spermatheca single, ovoid to retort-shaped, with slender, short, oblique neck. Male genitalia with moderately long, slender apicolateral processes on ninth tergum; basistyle without mesal hump, dististyle slender and curving to pointed tip; aedeagus small, triangular, with poorly developed distomedian process and a small blackish, heavily sclerotized subapical spot; parameres asymmetrical, basal apodemes broad; median process short, straight and slender, tapering to sharp point.

Distribution (Fig. 6).—Described from Sonora (Punta Santa Rosa, Puerto de Lobos, Punta Cirio, Cholla Bay) and Baja California (San Jose de Cabo), Mexico. The type series was swept from dry wrack (mainly eelgrass) on shore, and another series was taken among holes in pitted rhyolite rocks, covered with algae and exposed at low tide. The species has not previously been reported from California.

New records.—CALIFORNIA: *Orange Co.*—Seal Beach Weapons Station, Anaheim Bay Salt Marsh, V-6-1974, P. Moraes, light trap, 40 males, 45 females. This series was mounted on slides from a bulk collection containing approximately 37,000 *Dasyhelea* adults. Of 91 mounted *Dasyhelea,* 85 were *D. sonorensis* and 6 were *D. bajensis.*

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